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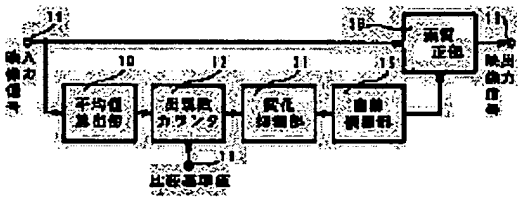
(54) IMAGE QUALITY CORRECTION CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an image quality correction circuit that conducts image quality correction processing with a correction characteristic in matching with number of incidences of each luminance level and does not cause deterioration in the image quality even when a distribution of incidences is largely changed.

SOLUTION: The image quality correction circuit is provided with a mean value calculation section 10 that calculates a mean value of luminance levels by each of 16 pixels in one frame on the basis of a received video signal, an incidence number counter 13 that counts the calculated incidence number of the luminance levels over N frames by each of a plurality of setting levels, a change suppression section 31 that suppresses a change in the count into a change for a period being multiples of the N-frame period and provided an output, a linear interpolation section 15 that forms a correction characteristic line through straight line interpolation on the basis of the count outputted from the change suppression section 31, and an image quality correction section 16 that corrects the received video signal according to the correction characteristic line. The correction characteristic line in matching with the count of the incidence number counter 13 is obtained, the change suppression section 31 suppresses a sudden change in the count of the incidence number counter 13 and gives the result to the linear interpolation section 15, which suppresses a change in the correction characteristic line.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] An image quality amendment circuit characterized by providing the following The number counter of appearances which carries out counting of the number of appearances of an intensity level of each pixel in the N frame (N is one or more integers) for two or more setting-out level ranges of every based on an input video signal The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period The linear interpolation section which forms amendment ultimate lines by linear interpolation based on enumerated data outputted from this change control section The image quality amendment section which amends an input video signal with amendment ultimate lines formed in this linear interpolation section
[Claim 2] An image quality amendment circuit characterized by providing the following The averaging section which computes the average of an intensity level every (m is two or more integers) m pixels based on an input video signal The number counter of appearances which carries out counting of the number of appearances of an intensity level computed in this average value calculation section over N frame period (N is one or more integers) for two or more setting-out level ranges of every The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period The linear interpolation section which forms amendment ultimate lines by linear interpolation based on enumerated data outputted from this change control section, and the image quality amendment section which amends an input video signal with amendment ultimate lines formed in this linear interpolation section
[Claim 3] An image quality amendment circuit characterized by providing the following The number counter of appearances which carries out counting of the number of appearances of an intensity level of each pixel in the N frame (N is one or more integers) for two or more setting-out level ranges of every based on an input video signal The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period The correction curve generation section which generates a new correction curve from enumerated data outputted from this change control section, and the set point set up beforehand The image quality amendment section which amends an input video signal by correction curve generated in this correction curve generation section
[Claim 4] An image quality amendment circuit characterized by providing the following The averaging section which computes the average of an intensity level every (m is two or more integers) m pixels based on an input video signal The number counter of appearances which carries out counting of the number of appearances of an intensity level computed in this average value calculation section over N frame period (N is one or more integers) for two or more setting-out level ranges of every The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period The correction curve generation section which generates a new correction curve from enumerated data outputted from this change control section, and the set point set up beforehand, and the image quality amendment section which amends an input video signal by correction curve generated in this correction curve generation section
[Claim 5] An image quality amendment circuit according to claim 1 or 3 characterized by providing the following The number counters of appearances are two or more judgment machines which judge whether an intensity level of each pixel is equivalent to each of two or more setting-out level ranges based on an input video signal. Two or more 1st counters which carry out counting of the count of a judgment of this judgment machine Two or more comparators which compare enumerated data of this 1st counter with a comparison reference value set up beforehand, and clear said 1st counter with a comparison output Two or more 2nd counters which carry out counting of the count of an output of this comparator, and are made into the number of appearances
[Claim 6] An image quality amendment circuit according to claim 2 or 4 characterized by providing the following The

number counters of appearances are two or more judgment machines which judge whether an intensity level computed in the average value calculation section is equivalent to each of two or more setting-out level ranges. Two or more 1st counters which carry out counting of the count of a judgment of this judgment machine Two or more comparators which compare enumerated data of this 1st counter with a comparison reference value set up beforehand, and clear said 1st counter with a comparison output Two or more 2nd counters which carry out counting of the count of an output of this comparator, and are made into the number of appearances

[Claim 7] It consists of a vessel, a coefficient multiplier, an adder, and an N frame delay machine. the change control section -- difference -- A vessel outputs difference of enumerated data of the number counter of appearances, and an output value of said N frame delay machine. said difference -- A coefficient of 1/X (X is two or more integers) is applied and outputted to an output value of a vessel. said coefficient multiplier -- said difference -- Said adder adds an output value of said coefficient multiplier to an output value of said N frame delay machine. said N frame delay machine is delayed by N frame in an aggregate value by said adder -- making -- said difference -- an image quality amendment circuit according to claim 1, 2, 3, or 4 which becomes as an output by which change was controlled while considering as an output to a vessel and an adder.

[Claim 8] It consists of a vessel, a coefficient multiplier, an adder, and an N frame delay machine. the change control section -- difference -- A vessel outputs difference of enumerated data of the 2nd counter, and an output value of said N frame delay machine. said difference -- A coefficient of 1/X (X is two or more integers) is applied and outputted to an output value of a vessel. said coefficient multiplier -- said difference -- said adder adds an output value of said coefficient multiplier to an output value of said N frame delay machine, and said N frame delay machine is delayed by N frame in an aggregate value by said adder -- making -- said difference -- an image quality amendment circuit according to claim 5 which becomes as an output by which change was controlled while considering as an output to a vessel and an adder.

[Claim 9] It consists of a vessel, a coefficient multiplier, an adder, and an N frame delay machine. the change control section -- difference -- A vessel outputs difference of enumerated data of the 2nd counter, and an output value of said N frame delay machine. said difference -- A coefficient of 1/X (X is two or more integers) is applied and outputted to an output value of a vessel. said coefficient multiplier -- said difference -- said adder adds an output value of said coefficient multiplier to an output value of said N frame delay machine, and said N frame delay machine is delayed by N frame in an aggregate value by said adder -- making -- said difference -- an image quality amendment circuit according to claim 6 which becomes as an output by which change was controlled while considering as an output to a vessel and an adder.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the image quality amendment circuit which amends image quality according to the content of an image (for example, gamma correction), when displaying an image with the display which uses a plasma display panel (PDP), a liquid crystal display panel (LCD panel), etc. as a display panel.
[0002]
[Description of the Prior Art] The conventional image-quality amendment circuit reads the amendment data which detected the average picture level (APL) to every one of the video signal inputted into the input terminal 12 frame (or 1 field), and corresponded to it from ROM14 by making this APL into the address by the average-value calculation section 10, and amends an input video signal in the image-quality amendment section 16 according to the input-output-conversion characteristic curve corresponding to this amendment data, and he was trying to output it from an output terminal 18, as shown in drawing 6 . APL adds the value which applied the number of distribution frequency for every intensity level about the total number of display dots of one frame (or 1 field), and with the total number of display dots, the division of it is done and it is calculated.
[0003] However, in the conventional example shown in drawing 6 , since image quality amendment data was decided based on APL, the display improvement of the content of an image distributed on the average could do brightness, but since it was not taken into consideration about the histogram (frequency distribution) of an intensity level, there was a trouble that amendment suitable for the content of an image could not be performed. For example, as shown in drawing 7 (a), there should be a case of the frequency distribution 1 currently concentrated on the side with a bright intensity level and a case of the frequency distribution 2 currently concentrated on the side with a dark intensity level as shown in this drawing (b). Thus, although distribution conditions differed, when both APL considered as the same thing, in the case of drawing 7 (a), the resolution of a bright side became low, and, in the case of this drawing (b), there was a trouble that the resolution of a dark side became low. There was a trouble that resolution became low to the narrow input video signal of the range of the frequency distribution of an intensity level especially.
[0004] In order to solve an above-mentioned trouble, these people proposed the image quality amendment circuit (Japanese Patent Application No. 11-92014) as already shown in drawing 8 and drawing 9 . The averaging section 10 which computes the average of an intensity level every (every [for example,] 16 pixels) m pixels based on the video signal inputted into the video-signal input terminal 12 according to the circuit shown in drawing 8 , The number counter 13 of appearances which was set up beforehand and which carries out counting of the number of appearances of the intensity level computed in this average value calculation section 10 over N frame period (N is one or more integers) for two or more setting-out level ranges of every, The linear interpolation section 15 which forms amendment ultimate lines by linear interpolation based on the enumerated data of this number counter 13 of appearances, and the image quality amendment section 16 which amends an input video signal with the amendment ultimate lines formed in this linear interpolation section 15 are provided.
[0005] As the number counter 13 of appearances is shown in drawing 10 , 16 judgment machines 170 and 171 and --1715, These judgment machines 170 and 171, the 1st counter 190 and 191 by which the series connection was carried out one by one to --1715, respectively, and --1915, It consists of comparators 210 and 211, --1215, and the 2nd counter 230 and 231 and --2315. Comparators 210 and 211 and the output of --1215 It was returned to the 1st counter 190 and 191 of the preceding paragraph, and --1915 as a clear signal, and the 2nd counter 230 and 231 and the output of --2315 were constituted so that it might be sent to the linear interpolation section 15.
[0006] And the video signal inputted into the video-signal input terminal 12 computes the average value of the intensity

level of 16 pixels in the average value calculation section 10, and carries out a sequential output. It is judged whether this average value is inputted into the judgment machines 170 and 171 corresponding to each level and --1715, and it is equivalent to each level. The total number of appearances in one frame is set to 255, and an intensity level is divided into 16 steps and, specifically, is detected. With the judgment vessel 170, it judges whether it corresponds by the 1st level from 0 level, and in the judgment machine 171, it judges whether it corresponds by the 2nd level from 0 level, and judges like the following whether it corresponds by the 16th level from 0 level with the judgment vessel 1715. Thus, it is judged whether it corresponds by the level concerned from 0 level altogether. When it corresponds, counting of the number of appearances is carried out by the 1st consecutive counter 190 and 191 and --1915.

[0007] Each 1st counter 190 and 191 and the number of appearances by which counting was carried out by --1915 are applied as one [the consecutive comparators 210 and 211 and] input of --1215, respectively. Moreover, the comparison reference value has inputted from the comparison reference-value input terminal 11 as an input of another side. Therefore, in each comparators 210 and 211 and --1215, if each 1st counter 190 and 191 and the number of appearances by which counting was carried out by --1915 exceed a comparison reference value, counting will be carried out by each 2nd counter 230 and 231 and --2315, and each 1st counter 190 and 191 and --1915 will be cleared. When the number which broke the total number of pixels of one frame by measurement size m (for example, m= 16) of averaging of the averaging section 10 is exceeded, the comparison reference value from the comparison reference-value input terminal 11 is set up by the degree type so that the value (amendment characteristic point) of the 2nd counter 2315 may be set to 255 (FF).

Comparison reference value = (the total number of pixels of one frame /m) /FF =w(number of longitudinal direction pixels) xh(number of lengthwise direction pixels) /16/255[0008] Said each 2nd counter 230 and 231 and the number of appearances of --2315 should be as follows.

c0: The number of appearances of the 2nd counter 230 between level 00-10 (10:16 ******).

c1: The number of appearances of the 2nd counter 231 between level 00-20 (20:16 ******).

.....

cE: The number of appearances of the 2nd counter 2314 between level 00-F0 (F0:16 ******).

cF: The number of appearances of the 2nd counter 2315 between level 00-100 (100:16 ******) (fixed value).

[0009] A horizontal axis outputs these 2nd counters 230 and 231, each c0 and c1 appearance of --2315, --cF as an amendment characteristic point when an intensity level and an axis of ordinate express as the number of appearances, as they show to drawing 11 . 16 steps of data which added the start point 00 to each c0 and c1 appearance and --cF sends to the linear interpolation section 15 -- having -- this linear interpolation section 15 -- each 00 appearances, c0 and c1, and -- the amendment ultimate lines which continued with the broken line which connected cE and cF in a straight line one by one, and carried out linear interpolation are obtained.

[0010] In the image quality amendment section 16, image quality amendment processing is performed based on amendment ultimate lines according the video signal inputted from the video-signal input terminal 12 to said linear interpolation section 15, and it outputs from the video-signal output terminal 18. When the intensity level of the video signal inputted from the video-signal input terminal 12 is x, image quality amendment processing is performed and, specifically, it outputs from the video-signal output terminal 18 so that it may be set to intensity-level y after amendment based on amendment ultimate lines. According to the circuit of drawing 8 as mentioned above, the optimal amendment property can be acquired according to the number of appearances of each level.

[0011] Moreover, the averaging section 10 which computes the average of an intensity level every (every [for example,] 16 pixels) m pixels based on the video signal inputted into the video-signal input terminal 12 according to the circuit shown in drawing 9 , The number counter 13 of appearances which carries out counting of the number of appearances of the intensity level computed in this average value calculation section 10 over the N frame (N is one or more integers) for two or more setting-out level ranges of every, The correction curve generation section 25 which generates a new correction curve based on the enumerated data of this number counter 13 of appearances and the set-point data set up beforehand, and the image quality amendment section 16 which amends an input video signal by the correction curve from this correction curve generation section 25 are provided.

[0012] And apart from this, the set-point data (set point) beforehand set to the straight-line up which connected the start point and the end point is inputted, it rearranges in order of an intensity level so that one side may complement between another side, and in the correction curve generation section 25, the number of appearances of the video signal inputted into the video-signal input terminal 12 is used alternately, and the Bezier curve passing through a start point as shown in drawing 12 and drawing 13 as a continuous line, and an end point is generated. In the image quality amendment section 16, image quality amendment is carried out based on a Bezier curve as shows the video signal inputted from the video-signal input terminal 12 to drawing 12 and drawing 13 as a continuous line, and it outputs from the video-signal output

terminal 18.
[0013] If it should be a property like frequency distribution 1 of having inclined in the center of abbreviation as the video signal inputted into the video-signal input terminal 12 showed the circuit of drawing 9 to drawing 7 (a) Unlike the case of drawing 11 , c0, c2, c4, c6, c8, cA, cC, and cE corresponding to the level 10, 30, 50, 70, and 90 in every other one, and B0, D0 and F0 for the number of appearances of the number counter 13 of appearances are used. It expresses that there are few appearances from these numbers of appearances between c0-c6 and between c8-cE, and there are many appearances between c6 and c8.
[0014] Moreover, the level 00, 20, 40, 60, and 80 on the straight line which connected the start point 00 and the end point TF, T0 and T2 corresponding to A0, C0, and E0, T four, and T6, T8, TA, TC and TE are inputted as set-point data from the set-point data input terminal 27. If these are rearranged in order of an intensity level, it is set to T0, c0, T2, c2, T four, and c4, T6, c6, T8, c8, TA, cA, TC, cC, TE and cE, and if linear interpolation is carried out, it will become the amendment line of a broken line shown in drawing 12 and drawing 13 by the dotted line like the proposed example of drawing 8 . When the Bezier curve which passes along a start point 00 and an end point TF by the circuit of drawing 9 by the correction curve generation section 25 based on two or more points which have arranged the number of appearances and set-point data by turns is generated, however, for example like the continuous line of drawing 12 To the straight line which connected the start point 00 and the end point TF, in a portion with high level, it swells a little more nearly up than a straight line, and the correction curve of the shape of S character which swells a little caudad is obtained from a straight line by the portion with low level. In the image quality amendment section 16, image quality amendment processing is performed based on the correction curve according the video signal inputted from the video-signal input terminal 12 to the correction curve generation section 25, and it outputs from the video-signal output terminal 18.
[0015] Moreover, if it should be a property like frequency distribution 2 of having inclined toward low level as the video signal inputted into the video-signal input terminal 12 showed drawing 7 (b), it expresses that there are few appearances and there are many appearances between c2 and c4 between c0-c2 and between c4-cE. It is made to be the same as that of the above. T0, c0, T2, c2, T four, c4, T6, c6, T8, c8, TA, When the Bezier curve which rearranges in order of cA, TC, cC, TE, and cE, and passes along a start point 00 and an end point TF by the correction curve generation section 25 is generated, for example like the continuous line of drawing 13 In a portion with high level, the correction curve which swells a little caudad from a straight line is obtained [a portion with low level] by the shape of an abbreviation straight line to the straight line which connected the start point 00 and the end point TF. In the image quality amendment section 16, image quality amendment processing is performed based on the correction curve according the video signal inputted from the video-signal input terminal 12 to the correction curve generation section 25, and it outputs from the video-signal output terminal 18.
[0016] Although the set-point data from the set-point data input terminal 27 was extracted from the straight line which connected the start point 00 and the end point TF in the circuit of drawing 9 Like the continuous line ultimate lines of drawing 12 instead of what is restricted to this In a portion with high level, by swelling a little more nearly up than a straight line, and extracting set-point data from the sigmoid curve which swells a little caudad from a straight line in a portion with low level By emphasizing a bright portion and a dark portion further, or using the set-point data of a reverse property, it can also set up so that light and darkness may seldom be emphasized. Moreover, it can make into the rate of arbitration to emphasize the data of a video signal not for the thing restricted when arranging the number of appearances, and set-point data by turns but for the number of appearances and set-point data as a rate of 2 to 1, or to emphasize set-point data for the number of appearances, and set-point data as a rate of 1 to 2 etc. Therefore, the optimal amendment property can be acquired according to the number of appearances of each level, and image quality amendment processing of having been suitable for any images can be performed. Moreover, with the point on the amendment property of arbitration, change of an extreme correction curve can be suppressed or the change according to the object or liking can be added to a curve.
[0017]
[Problem(s) to be Solved by the Invention] However, although the optimal amendment property doubled with the number of appearances of each level can be acquired in the image quality amendment circuit shown in drawing 8 and drawing 9 If a screen changes and the distribution condition of the number of appearances of an intensity level changes a lot at the time or the time of animation display in case an amendment characteristic point is computed and amended based on the number of appearances of the intensity level of each pixel of the input video signal within the N frame Change of the light and darkness by image quality amendment processing took lessons from the eye dramatically, and the trouble of causing image quality deterioration was.
[0018] While this invention can perform image quality amendment processing by the optimal amendment property

suitable for the number of appearances of each level like the image quality amendment circuit which it was made in view of the above-mentioned trouble, and was shown in drawing 8 and drawing 9 It aims at offering the image quality amendment circuit which can perform image quality amendment processing which does not cause image quality deterioration even if a screen changes and the distribution condition of the number of appearances of level changes a lot at the time or the time of animation display.

[0019]

[Means for Solving the Problem] The number counter of appearances with which an image quality amendment circuit by this invention carries out counting of the number of appearances of an intensity level of each pixel in the N frame (N is one or more integers) for two or more setting-out level ranges of every based on an input video signal, The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period, It is characterized by coming to provide the linear interpolation section which forms amendment ultimate lines by linear interpolation based on enumerated data outputted from this change control section, and the image quality amendment section which amends an input video signal with amendment ultimate lines formed in this linear interpolation section. In such a configuration, if an input video signal inputs into the number counter of appearances, counting of the number of appearances of an intensity level of each pixel in the N frame will be carried out for two or more setting-out level ranges of every by this number counter of appearances. Since that change is controlled in the change control section by change in a two or more times as many period as N frame period and enumerated data of this number counter of appearances are inputted into the linear interpolation section, change of amendment ultimate lines formed in this linear interpolation section is also controlled. In the image quality amendment section, amendment ultimate lines by which this change was controlled amend an input video signal, and image quality amendment processing is performed.

[0020] Moreover, the number counter of appearances with which an image quality amendment circuit by this invention carries out counting of the number of appearances of an intensity level of each pixel in the N frame for two or more setting-out level ranges of every based on an input video signal, The change control section which controls and outputs change of enumerated data of this number counter of appearances to change in a two or more times as many period as N frame period, It is characterized by coming to provide the correction curve generation section which generates a new correction curve from enumerated data outputted from this change control section, and the set point set up beforehand, and the image quality amendment section which amends an input video signal by correction curve generated in this correction curve generation section. In such a configuration, if an input video signal inputs into the number counter of appearances, counting of the number of appearances of an intensity level of each pixel will be carried out for two or more setting-out level ranges of every by this number counter of appearances. Since that change is controlled in the change control section by change in a two or more times as many period as N frame period and enumerated data of this number counter of appearances are inputted into the correction curve generation section, change of a correction curve generated in this correction curve generation section is also controlled. In the image quality amendment section, a correction curve by which this change was controlled amends an input video signal, and image quality amendment processing is performed.

[0021] In order to simplify a configuration of the number counter of appearances, the average calculation section which computes the average of an intensity level every m pixels based on an input video signal is prepared, and the number of appearances of an intensity level which the number counter of appearances computed in the average calculation section carries out counting for two or more setting-out level range of every with which it was set up beforehand.

[0022] Two or more judgment machines which judge whether an intensity level of each pixel is equivalent to each of two or more setting-out level ranges in the number counter of appearances based on an input video signal in order to simplify a configuration by making the number counter of appearances into adder needlessness, Two or more comparators which compare two or more 1st counters which carry out counting of the count of a judgment of this judgment machine, and enumerated data of this 1st counter with a comparison reference value set up beforehand, and clear said 1st counter with a comparison output, It constitutes from two or more 2nd counters which carry out counting of the count of an output of this comparator, and are made into the number of appearances.

[0023] Two or more judgment machines which judge whether an intensity level which computed the number counter of appearances in the average value calculation section is equivalent to each of two or more setting-out level ranges in order to simplify a configuration by making the number counter of appearances into adder needlessness, Two or more comparators which compare two or more 1st counters which carry out counting of the count of a judgment of this judgment machine, and enumerated data of this 1st counter with a comparison reference value set up beforehand, and clear the 1st counter with a comparison output, It constitutes from two or more 2nd counters which carry out counting of the count of an output of this comparator, and are made into the number of appearances.

[0024] in order to simplify a configuration of the change control section -- the change control section -- difference -- a vessel and a coefficient multiplier -- A vessel outputs difference of enumerated data of the number counter of appearances, and an output value of N frame delay machine. an adder and N frame delay machine -- constituting -- difference -- A coefficient of 1/X (X is two or more integers) is applied and outputted to an output value of a vessel. a coefficient multiplier -- difference -- an adder adds an output value of a coefficient multiplier to an output value of N frame delay machine, and N frame delay machine is delayed by N frame in an aggregate value by adder -- making -- difference -- while considering as an output to a vessel and an adder, it considers as an output by which change was controlled.

[0025]

[Embodiment of the Invention] The example of 1 operation gestalt of the image quality amendment circuit by this invention is explained based on drawing 1 - drawing 4 . In drawing 1 , the same portion as drawing 8 is made into the same sign, and omits explanation. drawing 1 -- setting -- 12 -- a video-signal input terminal and 10 -- for a comparison reference-value input terminal and 15, as for the image quality amendment section and 18, the linear interpolation section and 16 are [the averaging section and 13 / the number counter of appearances, and 11 / a video-signal output terminal and 31] the change control sections.

[0026] As shown in drawing 2 , said change control section 31 The 16 change control sections 310 and 311, --, It consists of a vessel 330, a coefficient multiplier 350, an adder 370, and an N frame delay machine 390. from 3115 -- becoming -- said change control section 310 -- difference -- said change control section 311 -- difference -- it consists of a vessel 331, a coefficient multiplier 351, an adder 371, and an N frame delay machine 391, and constitutes like the following -- having -- said change control section 3115 -- difference -- it consists of the vessel 3315, the coefficient multiplier 3515, an adder 3715, and an N frame delay machine 3915.

[0027] said difference -- vessels 330, 331, --, 3315 The number of appearances (enumerated data) outputted from the 2nd counter 230, 231, --, 2315 in said number counter 13 of appearances, said N frame delay machines 390 and 391, --, difference with the output value of 3915 -- outputting -- said coefficient multipliers 350, 351, --, 3515 -- said difference -- the output value of vessels 330, 331, --, 3315 -- 1/X (X is two or more integers) The coefficient of X= 2 is applied and outputted. For example, said adders 370 and 371, --, 3715 to the output value of said N frame delay machines 390, 391, --, 3915 Said coefficient multipliers 350 and 351, --, The output value of 3515 is added. Said N frame delay machines 390 and 391, --, 3915 is delayed by N frame in the aggregate value by said adders 370, 371, --, 3715 -- making -- said difference -- while considering as the output to vessels 330, 331, --, 3315 and adders 370, 371, --, 3715, it outputs to said linear interpolation section 15 as an output by which change was controlled.

[0028] The operation by the above configurations is used together and drawing 3 and drawing 4 are explained. N explains two or more integers and X about the case of the expedient top of explanation, N= 1, m= 16, and X= 2, although one or more integers and m should just be two or more integers.

[0029] (1) The video signal inputted into the video-signal input terminal 12 computes the average value of the intensity level of 16 pixels in the average value calculation section 10, and carries out a sequential output.

[0030] (2) If the average computed in the averaging section 10 inputs into the number counter 13 of appearances, this number counter 13 of appearances will act like the case of having proposed [which was shown in drawing 8 - drawing 10]. Each 2nd counter 230 and 231 in the number counter 13 of appearances and the number of appearances of --2315 consider as the thing of explanation which were c0, c1, --, cE and cF for convenience. Here, c0, c1, --, cE and cF express the following numbers of appearances.

c0: The number of appearances of the 2nd counter 230 between level 00-10 (10 is a hexadecimal display.).

c1: The number of appearances of the 2nd counter 231 between level 00-20 (20 is a hexadecimal display.).

.....

cE: The number of appearances of the 2nd counter 2314 between level 00-F0 (F0 is a hexadecimal display.)

cF: The number of appearances of the 2nd counter 2315 between level 00-100 (100 is a hexadecimal display.) (fixed value).

[0031] (3) If 16 steps of data which added the start point 00 to each c0 and c1 appearance of these 2nd counters 230, 231, --, 2315 and --cF is sent to the change control section 31 In this change control section 31, each c0 and c1 appearance, --, the change in the one-frame period (in the case of N= 1) of cE and cF are controlled and outputted to the change in a multiple frame period (a two or more times as many example as the N frame). However, since cF is a fixed value, it does not change. For example, as shown in drawing 3 (a), c0 appearance of the 2nd counter 230 With each continuous frame, "2", "2", "2", "2", "2", "16", If it should be set to "16", "16", "16", "16", "16", and "16" and should change from "2" to "16" rapidly in the frame periods FT and FT around t 6:00 As shown in this drawing (b), it changes with the depressant action of the change control section 31 to "9" from "2" in the one-frame period FT immediately after

t 7:00 which carried out one-frame period FT progress from t 6:00. It changes with "13", "15", and "16" in the one-frame each period FT immediately after t8 and t9 continuing, and t 10:00, and converges on "16." That is, the abrupt change in an one-frame period is controlled by the loose change in a four-frame period.
[0032] If the circuit of drawing 2 is used together and the depressant action of the above-mentioned change control section 31 is explained, it will become like a publication at ** of the following - **. The number of appearances of P0 and N frame delay machine 390 (amendment characteristic point) is set to PD0 for the number of appearances of the expedient top of explanation, and the 2nd counter 230 (amendment characteristic point).
[0033] ** If P0 should change to "16" from "2" in the one-frame period FT around t 6:00 as shown in drawing 3 (a), since it will be set to P0=16 and PD 0= 2 in this one-frame period FT, the number of appearances outputted from the change control section 310 is set to "2." this time -- difference -- the output {PD0+(P0-PD0) x1 / 2} of 7 (= 14/2) and an adder 370 is [the output (P0-PD0) of a vessel 330 / the output {(P0-PD0) x1 / 2} of 14 (= 16-2) and a coefficient multiplier 350] 9 (= 2+7).
[0034] ** Since the data which delayed one output of the adder 370 of the aforementioned ** in the one-frame period FT immediately after t 7:00 which carried out one-frame period FT progress from t 6:00 serves as an output (namely, PD0) of N frame delay machine 390, the number of appearances outputted from the change control section 310 is set to "9." this time -- difference -- the output {PD0+(P0-PD0) x1 / 2} of 4 (= the value which rounded off 7/2 of below decimal point.), and an adder 370 is [the output (P0-PD0) of a vessel 330 / the output {(P0-PD0) x1 / 2} of 7 (= 16-9) and a coefficient multiplier 350] 13 (= 9+4).
[0035] ** In the one-frame period FT immediately after t 8:00 which carried out one-frame period FT progress from t 7:00, the number of appearances outputted from the change control section 310 is set to "13" like the aforementioned **. At this time, the output of an adder 370 is 15 (= 13+2) like the aforementioned **.
[0036] ** In the one-frame period FT immediately after t 9:00 which carried out one-frame period FT progress from t 8:00, the number of appearances outputted from the change control section 310 is set to "15" like the aforementioned **. At this time, the output of an adder 370 is 16 (= 15+1) like the aforementioned **.
[0037] ** In the one-frame period FT immediately after t 10:00 which carried out one-frame period FT progress from t 9:00, the number of appearances outputted from the change control section 310 like the aforementioned ** is set to "16." At this time, the output of an adder 370 is 16 (= 16+0) like the aforementioned **.
[0038] (4) By the depressant action of the change control section 31, change of the numbers c1, --, cE of appearances of the other 2nd counters 231, --, 2314 also turns into a loose change in a multiple frame period, and output it. [as well as c0 appearance of the 2nd counter 230] When this is applied to the circuit of drawing 2 , the number of appearances of the 2nd counter 231, --, 2314 P1 (= c1), It is set to -- and P14 (= cE). The output value of N frame delay machines 391, --, 3914 PD1, --, It is set to PD14, and when it changes rapidly in an one-frame period with P1, --, P14, PD1, corresponding --, PD14 corresponding are controlled by the loose change in a multiple frame period.
[0039] (5) If change of the numbers c0 (= P0), c1 (= P1), --, cE (= P14) of appearances of the 2nd counter 230, 231, --, 2314 is controlled by loose change in the change control section 31 and is sent to the linear interpolation section 15 each 00 appearances by which change was controlled in this linear interpolation section 15, c0 and c1, and -- the amendment ultimate lines which connected cE and cF in a straight line one by one, and carried out linear interpolation are obtained.
[0040] For example, if the amendment ultimate lines obtained in the linear interpolation section 15 of drawing 8 proposed without the change control section 31 consider the case where it changes from the amendment ultimate lines U1 shown in drawing 4 by the dotted line in a certain one-frame period to the amendment ultimate lines U2 shown as a continuous line rapidly In the circuit by this invention shown in drawing 1 with the change control section 31, the change to U2 from the amendment ultimate lines U1 is controlled by the loose change over a multiple frame period. That is, since change of the numbers c0, c1, --, cE of appearances becomes loose in an operation of the change control section 31, as shown in drawing 4 , it changes gently with U1, U11, U12 (graphic display abbreviation), --, U2, amendment applying [which are generated in the linear interpolation section 15] them a multiple frame period (for example, 4-6-frame period), and they are converged on U2. Although it applied during the four-frame period and changed gently at this time as c0 appearance was described to the aforementioned ** - **, about the numbers c1, --, cE of appearances, it applies during the four-frame period according to that variation, and it changes gently, or it applies other than four during two or more (5 for example, 6) frames, and changes gently. In drawing 4 , the amendment ultimate lines U11 are equivalent to the amendment ultimate lines in the one-frame period immediately after t 7:00 which carried out one-frame period progress from t 6:00 of drawing 3 , and c0 on these amendment ultimate lines U11 (the number of appearances of the 2nd counter 230) corresponds "9" of the aforementioned **.
[0041] (6) In the image quality amendment section 16, perform image quality amendment processing based on amendment ultimate lines according the video signal inputted from the video-signal input terminal 12 to the linear

interpolation section 15, and output from the video-signal output terminal 18. When the intensity level of the video signal inputted from the video-signal input terminal 12 is x, image quality amendment processing is performed and, specifically, it outputs from the video-signal output terminal 18 so that it may be set to intensity-level y after amendment based on amendment ultimate lines.

[0042] While being able to perform image quality amendment processing by the optimal amendment property doubled with the number data of appearances of each level according to the example of an operation gestalt of above drawing 1 , when the distribution condition of the number of appearances of an intensity level changes a lot, image quality amendment processing which controls this change and does not cause image quality deterioration can be performed.

[0043] Drawing 5 shows other examples of an operation gestalt of this invention, and the configuration in the case of the example of an operation gestalt shown in drawing 1 and drawing 2 and the changing place of the video-signal input terminal 12, the averaging section 10, the number counter 13 of appearances, the image quality amendment section 16, the video-signal output terminal 18, and the 31 change control section are not in this drawing. The place by which it is characterized [of this example of an operation gestalt] is the point of having formed the correction curve generation section 25 instead of the linear interpolation section 15 of drawing 1 . This correction curve generation section 25 generates a new correction curve from the number of appearances by which counting was carried out with the number counter 13 of appearances, and change was controlled in the change control section 31, and the set-point data beforehand set up from the set-point data input terminal 27, and inserts it between the change control section 31 and the image quality amendment section 16. A circuit which generates the Bezier curve which passes along a start point 00 and an end point TF based on two or more points to which said correction curve generation section 25 has arranged for example, the number of appearances and set-point data by turns is used.

[0044] Below, an operation of drawing 5 is used together and drawing 7 , drawing 9 , drawing 12 , and drawing 13 are explained.

(1) As the video signal inputted into the video-signal input terminal 12 showed drawing 7 (a), it should be a property like frequency distribution 1 of having inclined in the center of abbreviation. As the number of appearances of the number counter 13 of appearances, c0, c2, c4, c6, c8, cA, cC, and cE corresponding to the level 10, 30, 50, 70, and 90 in every other one, and B0, D0 and F0 are used like the proposed example of drawing 9 . Moreover, the level 00, 20, 40, 60, and 80 on the straight line which connected the start point 00 and the end point TF, T0 and T2 corresponding to A0, C0, and E0, T four, and T6, T8, TA, TC and TE are inputted as setting-out data from the set-point data input terminal 27. then, in the proposed example of drawing 9 without the change control section 31 By the correction curve generation section 25, the number data c0, c2, c4, c6, c8, cA, cC, and cE of appearances, It carries out the set-point data T0 and T2, T four, and based on two or more points which have arranged T6, T8, TA, TC, and TE by turns. When the correction curve V of the shape of S character as shown in drawing 12 as a continuous line (Bezier curve) is obtained and the numbers c0, c2, c4, c6, c8, cA, cC, and cE of appearances change rapidly, according to this, a correction curve V changes from V1 to V2 rapidly (V1 and V2 are a graphic display abbreviation). however, in the example of an operation gestalt of drawing 5 with the change control section 31 Since the change in the one-frame period of the numbers c0, c2, c4, c6, c8, cA, cC, and cE of appearances is controlled by the loose change over a multiple frame period The correction curve V generated in the correction curve generation section 25 according to this changes gently with V1, V11, V12, --, V2 for every one-frame period, and is converged on V2 (V11 and V12 are a graphic display abbreviation). In the image quality amendment section 16, image quality amendment processing is performed based on the correction curve according the video signal inputted from the video-signal input terminal 12 to said correction curve generation section 25, and it outputs from the video-signal output terminal 18.

[0045] (2) As the video signal inputted into the video-signal input terminal 12 showed drawing 7 (b), it should be a property like frequency distribution 2 of having inclined toward low level. In the proposed example of drawing 9 without the change control section 31, like the above (1) By the correction curve generation section 25, the number data c0, c2, c4, c6, c8, cA, cC, and cE of appearances, It carries out the set-point data T0 and T2, T four, and based on two or more points which have arranged T6, T8, TA, TC, and TE by turns. When the correction curve W (Bezier curve) as shown in drawing 13 as a continuous line is obtained and the numbers c0, c2, c4, c6, c8, cA, cC, and cE of appearances change rapidly, according to this, a correction curve W changes from W1 to W2 rapidly (W1 and W2 are a graphic display abbreviation). however, in the example of an operation gestalt of drawing 5 with the change control section 31 Since the change in the one-frame period of the number data c0, c2, c4, c6, c8, cA, cC, and cE of appearances is controlled by the loose change over a multiple frame period The correction curve W generated in the correction curve generation section 25 according to this changes gently with W1, W11, W12, --, W2 for every one-frame period, and is converged on W2 (W11 and W12 are a graphic display abbreviation). In the image quality amendment section 16, image quality amendment processing is performed based on the correction curve according the video signal inputted

from the video-signal input terminal 12 to said correction curve generation section 25, and it outputs from the video-signal output terminal 18.

[0046] Although the set-point data from the set-point data input terminal 27 was extracted from the straight line which connected the start point 00 and the end point TF in the example of an operation gestalt of drawing 5 Like the continuous line ultimate lines of drawing 12 instead of what is restricted to this, in a portion with high level It swells a little more nearly up than a straight line. In a portion with low level By extracting set-point data from the shape of S character which swells a little caudad from a straight line, by emphasizing a bright portion and a dark portion further, or using the set point of a reverse property, it can also set up so that light and darkness may seldom be emphasized. Moreover, it can make into the rate of arbitration to emphasize the data of a video signal for not the thing restricted when arranging the number data of appearances, and set-point data by turns but the number data of appearances, and set-point data as a rate of 2 to 1, or to emphasize set-point data for the number data of appearances, and set-point data as a rate of 1 to 2 etc.

[0047] While being able to perform image quality amendment processing by the optimal amendment property doubled with the number data of appearances of each level according to the example of an operation gestalt of above drawing 5 , image quality amendment processing which does not cause image quality deterioration even if the distribution condition of the number of appearances of the intensity level of each pixel changes a lot can be performed. Moreover, with the point on the amendment property of arbitration, change of an extreme correction curve can be suppressed or the change according to the object or liking can be added to a curve.

[0048] Although the case where the averaging section was prepared was explained in said example of an operation gestalt in order to simplify the configuration of the number counter of appearances, this invention cannot be restricted to this and can be used also about the case where the averaging section is omitted.

[0049]

[Effect of the Invention] The number counter of appearances with which the image quality amendment circuit by this invention carries out counting of the number of appearances of the intensity level of each pixel in the N frame for two or more setting-out level ranges of every based on an input video signal, The change control section which controls and outputs change of the enumerated data of this number counter of appearances to the change in a two or more times as many period as N frame period, Since the linear interpolation section which forms amendment ultimate lines by linear interpolation based on the enumerated data outputted from this change control section, and the image quality amendment section which amends an input video signal with the amendment ultimate lines formed in this linear interpolation section were provided While being able to perform image quality amendment processing by the optimal amendment property doubled with the number of appearances of the intensity level of each pixel in the N frame Even if a screen changes and the distribution condition of the number of appearances of an intensity level changes a lot at the time or the time of animation display, image quality amendment processing which controls this change and does not cause image quality deterioration can be performed.

[0050] The number counter of appearances with which the image quality amendment circuit by this invention carries out counting of the number of appearances of the intensity level of each pixel in the N frame for two or more setting-out level ranges of every based on an input video signal, The change control section which controls and outputs change of the enumerated data of this number counter of appearances to the change in a two or more times as many period as N frame period, Since the correction curve generation section which generates a new correction curve from the enumerated data outputted from this change control section and the set point set up beforehand, and the image quality amendment section which amends an input video signal by the correction curve generated in this correction curve generation section were provided While being able to perform image quality amendment processing by the optimal amendment property doubled with the number of appearances of the intensity level of each pixel in the N frame Even if a screen changes and the distribution condition of the number of appearances of an intensity level changes a lot at the time or the time of animation display, image quality amendment processing which controls this change and does not cause image quality deterioration can be performed. Moreover, with the point on the amendment property of arbitration, change of an extreme correction curve can be suppressed or the change according to the object or liking can be added to a curve.

[0051] The average calculation section which computes the average of an intensity level every m pixels based on an input video signal is prepared, and when it constitutes so that the intensity level which computed the number counter of appearances in the average calculation section may carry out counting of the number which appears in each of two or more setting-out level ranges set up beforehand over N frame period, the configuration of the number counter of appearances can be simplified.

[0052] Two or more judgment machines which judge whether it is equivalent to each of two or more setting-out level

ranges where the intensity level for every pixel was beforehand set up in the number counter of appearances based on the input video signal, Two or more comparators which compare two or more 1st counters which carry out counting of the count of a judgment of this judgment machine, and the enumerated data of this 1st counter with the comparison reference value set up beforehand, and clear the 1st counter with a comparison output, When constituted from two or more 2nd counters which carry out counting of the output of this comparator, and are made into the number of appearances, a configuration can be simplified being able to use an adder as unnecessary for the number counter of appearances.

[0053] It constitutes from a vessel, a coefficient multiplier, an adder, and an N frame delay machine. the change control section -- difference -- A vessel outputs the difference of the enumerated data of the number counter of appearances, and the output value of N frame delay machine. difference -- The coefficient of 1/X (for example, 1/2) is applied and outputted to the output value of a vessel. a coefficient multiplier -- difference -- an adder adds the output value of a coefficient multiplier to the output value of N frame delay machine, and N frame delay machine is delayed by N frame in the aggregate value by the adder -- making -- difference, when it constitutes so that it may consider as the output by which change was controlled while considering as the output to a vessel and an adder The configuration of the change control section can be simplified.

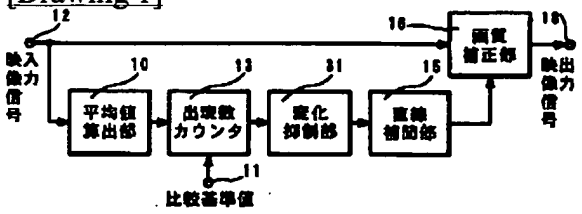
[Translation done.]

* NOTICES *

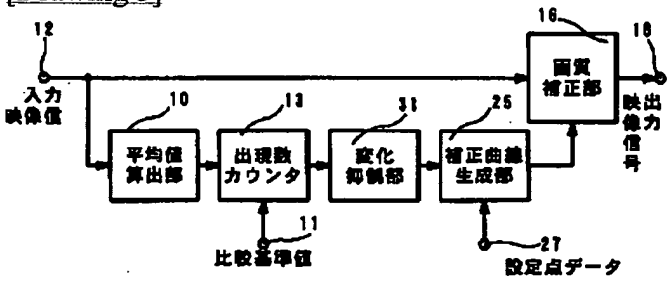
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

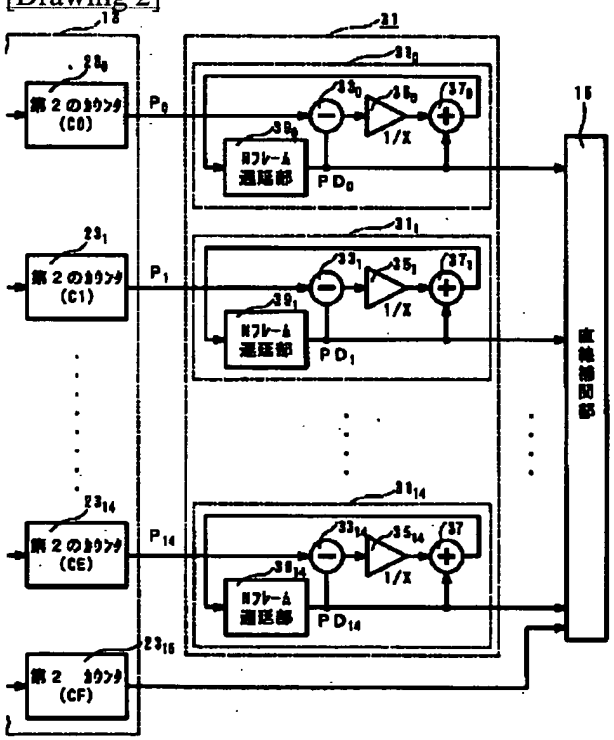
[Drawing 1]



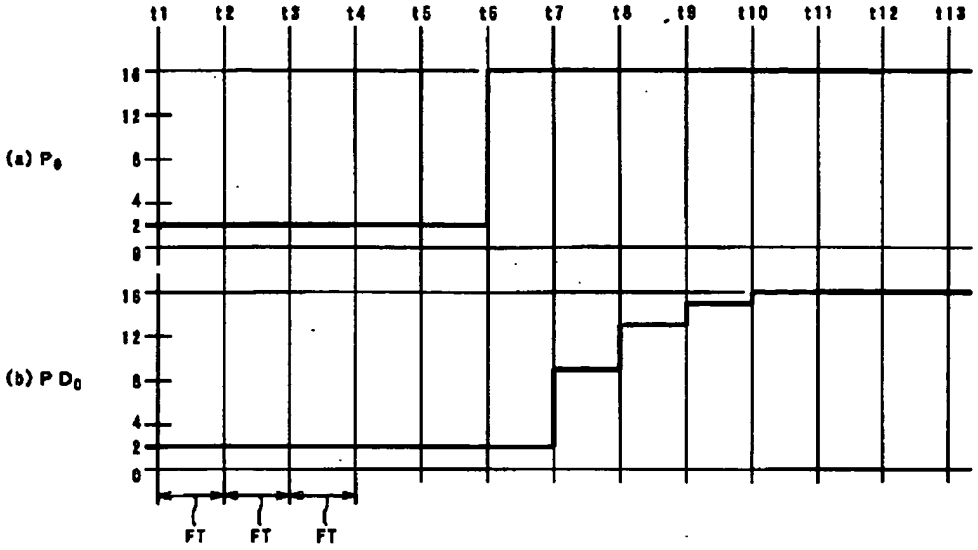
[Drawing 5]



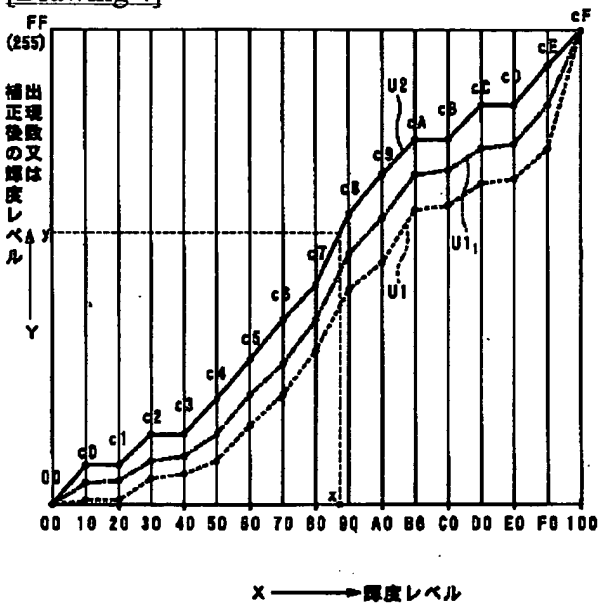
[Drawing 2]



[Drawing 3]



[Drawing 4]



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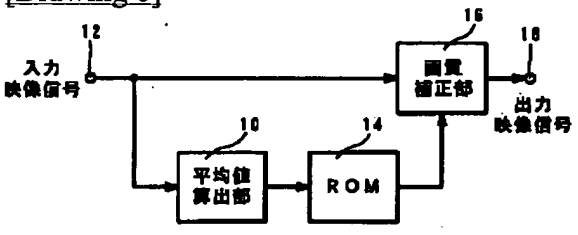
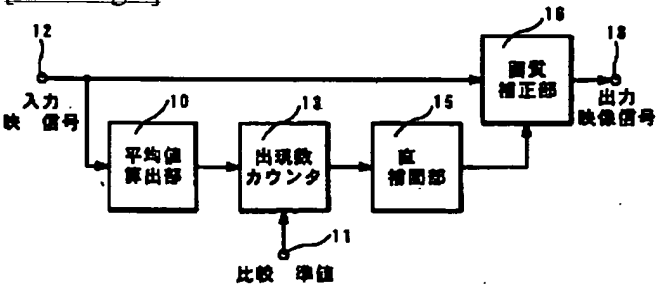
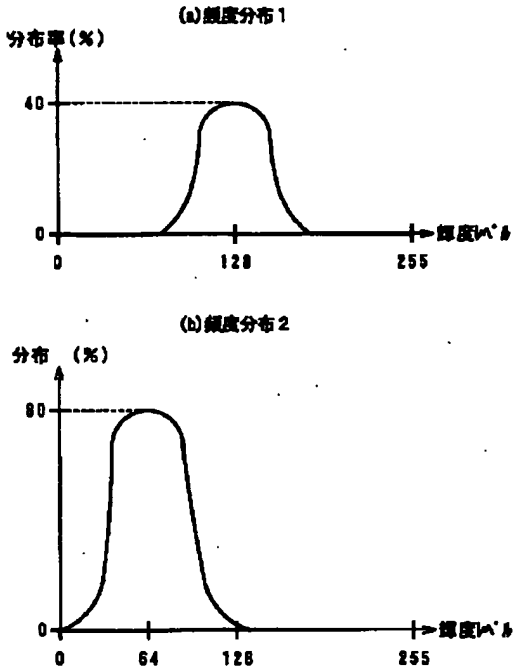


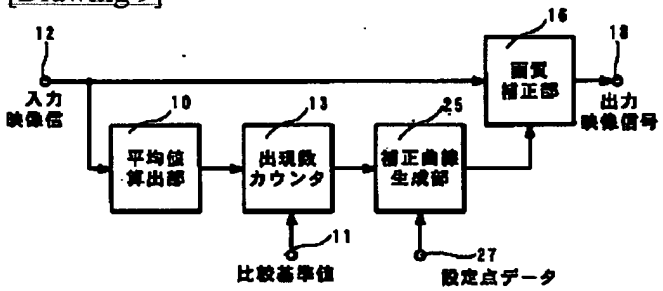
[Drawing 8]



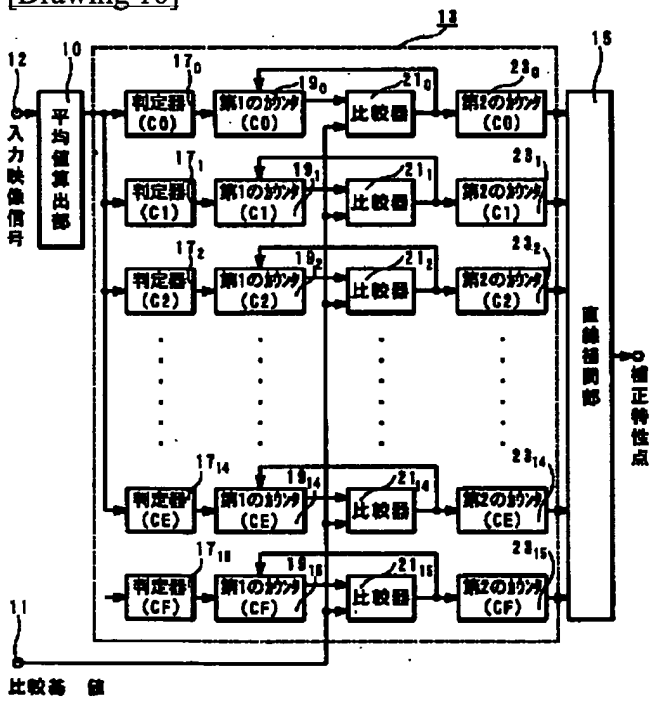
[Drawing 7]



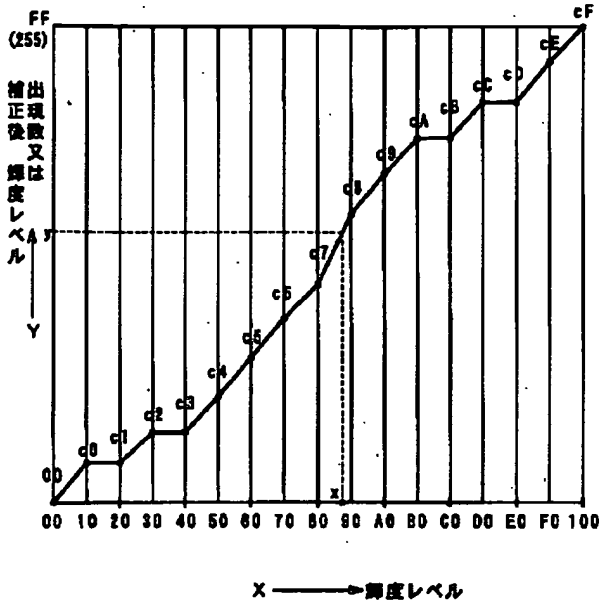
[Drawing 9]



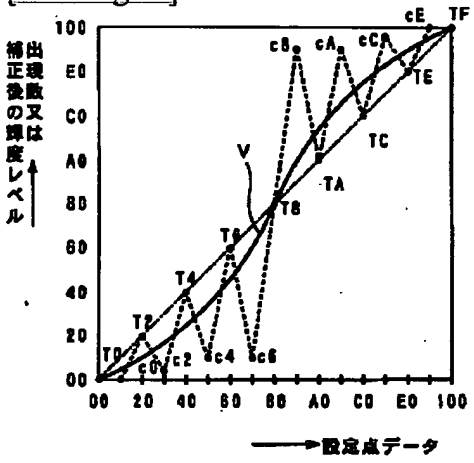
[Drawing 10]



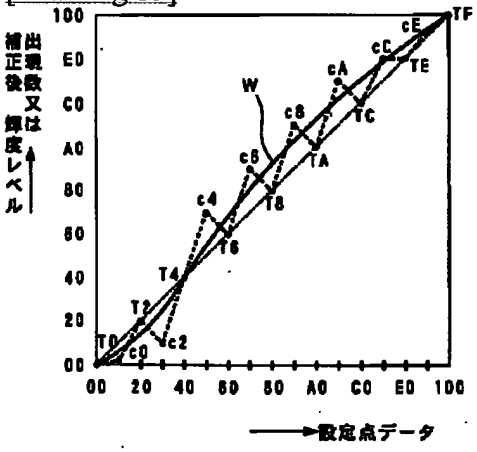
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]